



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

International Journal of Current Research  
Vol. 10, Issue, 04, pp.68461-68464, April, 2018

INTERNATIONAL JOURNAL  
OF CURRENT RESEARCH

## RESEARCH ARTICLE

### A STUDY ON FUTURE OF NUCLEAR ENERGY

Anshul Jain and \*Dr. Dimple

Aggarwal College, Ballabgarh, Faridabad, Haryana

#### ARTICLE INFO

##### Article History:

Received 19<sup>th</sup> January, 2018

Received in revised form

07<sup>th</sup> February, 2018

Accepted 29<sup>th</sup> March, 2018

Published online 30<sup>th</sup> April, 2018

##### Key words:

Nuclear Energy,  
Calorific Value,  
Ignition.

#### ABSTRACT

A good source of energy provides adequate calorific value at normal ignition temperature with no or at least at minimum damage to environment and people. The main objectives of this study are to identify the facts converting the sources of nuclear energy into reasons for future disaster of people, environment and earth. The study also works on the prospects of Energy from Nuclear Fusion. The results of the study disclose that radiation (emitted outside during nuclear fission), Nuclear waste or Nuclear accidents are not responsible for any type of disaster to this society because they are released in a planned and monitored way thus not resulting in a disaster at all. We can see a bright future in Nuclear Fission and Fusion process if guided by a noble motive of doing welfare to society; not for satisfying one's greed to control others.

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Citation: Anshul Jain and Dr. Dimple. 2018. "A study on future of nuclear energy", *International Journal of Current Research*, 10, (04), 68461-68464.

## INTRODUCTION

The science of atomic energy came into existence from 1895 when Wilhelm Rontgen discovered ionizing radiation. In 1938, Lise Meitner and Otto Frisch working under Neil Bohr; explained that neutrons caused severe vibration in nucleus when captured by it. And the result is the splitting of nucleus into 2 or 3 parts releasing energy near about 200 million volts. But it was in 1939 when this nuclear development sparked activities in many laboratories. Hahn and Strassmann showed that such fission results in energy along with extra nucleus of light element thus causing a self-sustaining chain reaction of nucleus. During the period of 1939 to 1945 developments were focused on atomic bombs. The result was the Nuclear attack on Hiroshima and Nagasaki of Japan in 1945. This may be the reason why nuclear energy is a threat for common people rather than a hope. But from 1945 attention was given to harness such energy in a controlled way for naval propulsion and generating electricity. A source of energy provides a good amount of energy in a convenient form over a long period of time. Nuclear Energy is exhausted from Nuclear Fuel which is a non-renewable source of energy because once exhausted, it cannot be quickly replaced. Nuclear Reaction results in radioactive waste whether it is nuclear fission or nuclear fusion.

This is the undesired result of nuclear reaction because the 100% disposal of such waste has been remained impossible till now. This paper covers the conceptual details regarding nuclear system. It is an attempt to find out a clear insight about the prospect of nuclear energy by analysing its various aspects.

#### Litreture Review

Nuclear energy is not a novice concept. It has been adopted since 1939. But till today, it has been facing several problems. The biggest among of these problems is its economic unaffordability (Ramana, 2018). Even the small modular reactors (SMRs) cannot make nuclear energy affordable. Also the increasing availability of renewable sources of energy (Wind, Solar) is giving a tough competition to nuclear energy. In all such circumstances, it is going to be very tough for nuclear energy to stand over all sources of energy. (Valoración, 2017) Despite the negative aspects of cost, radioactive waste or nuclear accidents, one cannot ignore the applications of nuclear technology in various fields of life whether directly or indirectly such as in industrial, medicinal, military or food. Working with different isotopes of same element can add a lot to our lives. (World Energy Outlook 2017) There is an appetent 'Sustainable Development Scenario' requiring the provision of clean and reliable energy source not contributing at all or contributing to the least in the environmental pollution, among other aims.

\*Corresponding author: Dr. Dimple,  
Aggarwal College, Ballabgarh, Faridabad, Haryana.

Nuclear energy is competent to fit with the aim as it does not have any carbon emissions thus maintaining and improving the quality of air.

## RESEARCH METHODOLOGY

The study is based on data collected from secondary sources. The study is conceptual in nature. It uses facts more than the numeric data. The study aims to analyse the different aspects of nuclear energy to understand its effect in a cumulative form.

### The paper aims to study the following objectives

1. To understand the concept of Nuclear energy
2. To identify the facts making Nuclear activities the reason for future disaster
3. To see prospect of nuclear fusion

## DISCUSSION

### Concept of Nuclear Energy

Nuclear energy is the energy released during a nuclear reaction. A physical reaction which involves changes in the nucleus of an atom is known as nuclear reaction.

### The nuclear energy can be obtained in 2 ways

Nuclear fission - By splitting heavy nucleus into smaller nuclei with low energy neutron.

### The nuclear equation is



Figure 1. Working Mechanism of nuclear fission

The neutrons produced in this process can lead to a self sustaining chain reaction. When all the neutrons produced during such fission are allowed to cause further fission then so much energy is produced in a little time that cannot be controlled resulting in the explosion known as ATOM BOMB.

**Nuclear fusion:** By combining two nuclei of light element to form a heavy nucleus. This fusion is the source of energy for sun.

### The nuclear equation is

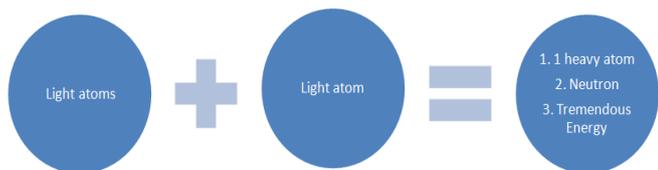


Figure 2. Working Mechanism of nuclear fusion

When atom bomb is exploded, then it produces a lot of heat energy thus raising the temperature of light atoms in a few microseconds. At this temperature, fusion takes place producing a tremendous amount of energy. This is what explodes a HYDROZEN BOMB. The energy so produced has not been controlled so far.

## Different aspects of Nuclear Energy

Nuclear energy is more than just a source of energy. It is applied worldwide in medicinal, agricultural, environmental and military areas. Also it is considered to be a dangerous source of energy; may be because of its continuous radiation emission, nuclear accidents or nuclear bomb developments. So we considered its following aspects to determine its efficiency as a source of energy.

### Economic Concern

A good source of energy should be cost competitive. One can consider the source economic if it is capable of providing the reasonable or maximum output at low cost (capital, operating and finance) justified in terms of profitability. Let's have a look at the following table:

### As we can see

- Coal is the largest contributor of world's electricity. Its calorific value is also higher than gas and nuclear sources. At the same time, it does not require high initial capital investment thus making it affordable. That's why finance and discount rate are not big factors affecting its cost. So Coal is considered to be the economic source of energy.
- Gas (depending on the technology) gives moderate output at reasonable capital investment. Also it is cheaper to operate if there is a direct access to fuels. Thus all the factors make it an economic source.
- Nuclear energy's lifetime cost is lower than coal and gas. It also require huge initial capital investment and takes approximately 4-5 years to start. This lead to importance of finance factor. However it is affordable and comparable with other sources at 3% discount rate but goes expensive with increase in discount rate. But its operating cost is cheaper than above mentioned sources. Also, the plants have operating life near about 60 years. If we are able to manage its initial capital cost, we can say that Nuclear energy is an economic source.

However, till now it has not become possible to control the initial capital cost of nuclear plant. That's why it still comes into the category of high capital projects making it unaffordable for typical electrical utility or small country.

### Safety Concern

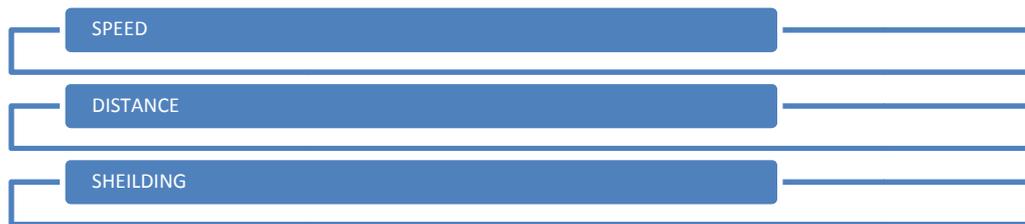
Karen Hadden (Director of the Sustainable Energy and Economic Development Coalition), has rallied many groups insisting on the fact that nuclear power is unsafe. It is costly and diverts dollars from energy efficiency, solar, wind and other energy-storage technologies. While at the same time, David Crane, the President of NRG association says that Nuclear has the power to fight against global warming. We have two different opinions of two group leaders moving towards the same aim of protecting the environment, people and resources. People in United States averred the building of new nuclear power plant after the Chernobyl disaster in 1986 and Three Mile Island accident in 1979. These accidents led a fact that it is unsafe to run the nuclear power plants. But many of the major nuclear accidents have been directly attributable to operator or human error like in case of Chernobyl disaster.

**Table 1. Comparative view of three main sources of energy**

Source of energy	Energy Contributor	Calorific Value	Project Cost	Operating Cost	Finance Factor
1. Coal	Biggest	12.3-14 c/kWh	Affordable	Normal	Minor Effect
2. Gas	2nd after Coal	5.7-10.9 c/kWh	Affordable	Normal	Minor Effect
3. Nuclear	Comes at same Place with hydro	9.9 c/kWh	Initial Cost very High varying with Discount rate	Cheaper Than fossil Fuels	A big cost Factor

**Table 2. contribution in world in electricity by three source of energy**

Sources of energy	Contribution in world in electricity	Long term result	Other effect
Coal and Gas	Near about 39% + 22% Respectively	Many million air pollution-related deaths globally	Its radiation is 100 time Greater than of nuclear + Carbon Emission
Nuclear power	Near about 11%	More property loss if Exposed to an accident than human loss	Radiation only

**Figure 3. Three steps protection from radiation****Table 3. Nuclear electricity production from its start**

Time period	Nuclear Electricity Production ( TWH )
1. 1950-1970	>75
2. 1970-1980	500-600
3. 1980-1990	1750-2000
4. 1990-2000	2400-2500
5. 2000-2010	>2500
6. 2010- till now	<2000

**Table 4. Amount of nuclear warheads and nuclear electricity generation in nine countries heading nuclear power**

Country	Total Nuclear Warheads	Deployed Nuclear Warheads	Nuclear Electricity Generation (TWH)
<u>United States</u>	6,800	1800	805 ( 20% of country electricity)
<u>Russia</u>	7000	1950	180 ( 17% of country electricity)
<u>United Kingdom</u>	215	120	60 ( 20% of country electricity)
<u>France</u>	300	280	384 ( 72% of country electricity)
<u>China</u>	270	?	215 ( 4% of country electricity)
<u>India</u>	110-120	0	40 ( 3% of country electricity)
<u>Pakistan</u>	120-130	0	5-7 ( 4% of country electricity)
<u>North Korea</u>	?	?	?
<u>Israel</u>	60-400	?	?

Also accidents do not happen in area of nuclear plants only. Benxihu Colliery Disaster (1942), Wankie coal mine disaster, Bhopal gas tragedy are the examples of accidents that happen in fields of coal and gas. Now have a look at the following: It is very easy to shut down the nuclear plant to control accidents. But it would be advisable to control such accidents by improving the safety measures.

### Environmental concern

The most publicity in past years have been given to the greenhouse effect. The changing Earth's climate; acid rain, and air pollution is degrading our quality of life in many ways. We have different sources of energy like coal, oil, gas, hydro, sea wave or tidal, solar, air and nuclear. But among all the sources, Coal is the most deployed source of energy even when we know that it is biggest contributor of carbon gas emission. The second place takes gas both in contribution to energy and pollution. Still they are widely used.

Nuclear energy sources are also considered to be environmentally unsafe even when we know that they do not emit carbon gases. The reason is radiation emission during nuclear reaction and radioactive waste after reaction. It is true that management and disposal of nuclear waste is very difficult. But there is a proper mechanism guiding and monitoring such waste. In our findings we came to know about the following facts:

- A nuclear power plant produces small amounts of radioactive gases, liquids and direct radiation. Within 50 miles of a nuclear power plant, you would receive radiation about 0.01 millirem/ year while the average person in the US receives radiation dose of 300 millirem/year from natural sources of radiation.
- All people have internal radiations from natural resources and inside their body.

- A job worker in coal mine is exposed to disease at a much higher level than a worker of nuclear plant. Workers at nuclear plant receive only minimal radiation. They rarely become contaminated with radiation.
- Radiation should not be the sole reason of avoiding nuclear power plant or reactor. A safety measure can help us to continue with nuclear power i.e.
- The radioactive material; produced during normal operations; is held for a time period so that the radioactivity level reduces before being released in a planned, monitored way. This keeps the amount of radioactive material within regulatory limits.
- Timely samples taken from air, water, fish and vegetables etc.; are analysed to keep an eye on level of radiation.
- These all measures make the environment free from pollution and danger of Nuclear energy.

### Weapons Proliferation Concern

The nuclear bomb attack on Hiroshima and Nagasaki in Japan thrilled the whole world. These attacks changed the image of nuclear energy in mind of common people. It became a threat more than a hope. However, after that attack, concern was shifted from nuclear bomb to nuclear energy. This can be analysed as follow:

### Also have a look at the following

This can be seen from the first table that the production of electricity was on a rise till 2010 but after that it began to decline. In second table, it is clear that even after the Hiroshima and Nagasaki Disaster, the countries remained indulged in producing nuclear weapons. They are concentrated on nuclear energy as well as on the nuclear atomic power. All this presents nuclear as a threat to people.

### To see prospect of nuclear fusion

Nuclear Fusion is the main source of energy in SUN. Till now, no one has got success in nuclear fusion process. We can see a bright prospect in a controlled nuclear fusion which is a dream till yet.

### Conclusion

It is true that cost of building a nuclear plant is not cheap but it will prove one of the best economic ways to make electricity. The favourable aspects of nuclear power overtake its negative aspects. The long term results are much better than other sources of energy (Coal, gas or oil). The nuclear energy alone cannot satisfy the emerging demand of electricity but it will stand like those pillars on which other renewable sources of energy will get their place. Nuclear energy is a hope in true sense but the reality is that the greed of nations to become stronger and control others has given it a face of emerging threat.

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